

SINGLE-SUPPLY OPERATIONAL AMPLIFIERS

MicroAmplifier™ Series

FEATURES

- **MICRO-SIZE, MINIATURE PACKAGES:**
 - Single: SOT23-5, SO-8
 - Dual: MSOP-8, SO-8
 - Quad: SSOP-16 (Obsolete)
- **LOW OFFSET VOLTAGE: 750 μ V max**
- **WIDE SUPPLY RANGE:**
 - Single Supply: +2.7V to +36V
 - Dual Supply: ± 1.35 V to ± 18 V
- **LOW QUIESCENT CURRENT: 350 μ V max**
- **WIDE BANDWIDTH: 1.5MHz**

APPLICATIONS

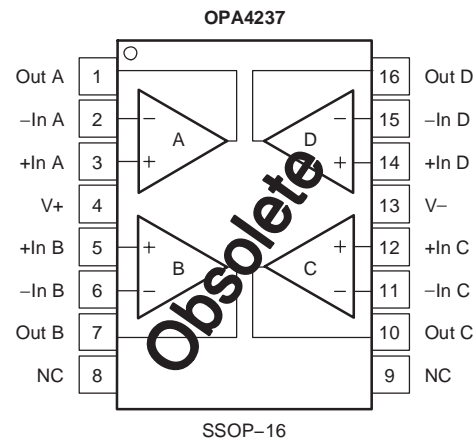
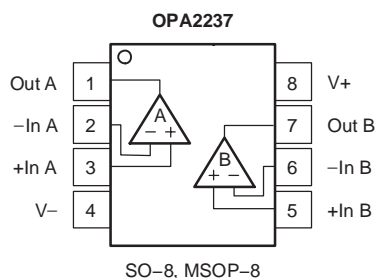
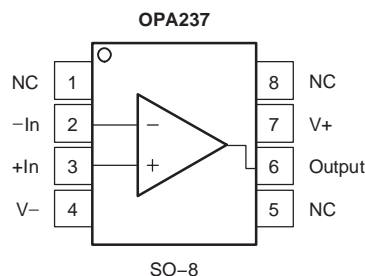
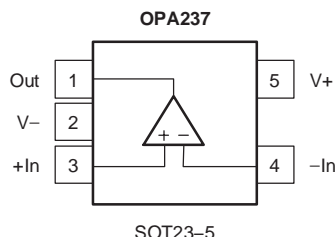
- BATTERY-POWERED INSTRUMENTS
- PORTABLE DEVICES
- PCMCIA CARDS
- MEDICAL INSTRUMENTS
- TEST EQUIPMENT

DESCRIPTION

The OPA237 op amp family is one of Texas Instruments' MicroAmplifier™ series of miniature products. In addition to small size, these devices feature low offset voltage, low quiescent current, low bias current, and a wide supply range. Single, dual, and quad versions have identical specifications for maximum design flexibility. They are ideal for single-supply, battery-operated, and space-limited applications, such as PCMCIA cards and other portable instruments.

OPA237 series op amps can operate from either single or dual supplies. When operated from a single supply, the input common-mode range extends below ground and the output can swing to within 10mV of ground. Dual and quad designs feature completely independent circuitry for lowest crosstalk and freedom from interaction.

Single, dual, and quad are offered in space-saving surface-mount packages. The single version is available in the ultra-miniature 5-lead SOT23-5 and SO-8 surface-mount. The dual version comes in a miniature MSOP-8 and SO-8 surface-mount. The quad version is obsolete. MSOP-8 has the same lead count as a SO-8 but half the size. The SOT23-5 is even smaller at one-fourth the size of an SO-8. All are specified for -40°C to $+85^{\circ}\text{C}$ operation. A macromodel is available for design analysis.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

MicroAmplifier is a trademark of Texas Instruments. All other trademarks are the property of their respective owners.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Supply Voltage, V+ to V–	36V
Input Voltage	(V–) –0.7V to (V+) +0.7V
Output Short-Circuit ⁽²⁾	Continuous
Operating Temperature Range	–55°C to +125°C
Storage Temperature Range	–55°C to +125°C
Junction Temperature Range	+150°C

(1) Stresses above these ratings may cause permanent damage.

Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) Short circuit to ground, one amplifier per package.



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE/ORDERING INFORMATION⁽¹⁾

PRODUCT	PACKAGE-LEAD	PACKAGE DRAWING	PACKAGE MARKING
Single			
OPA237NA	SOT23-5	DBV	A37A
OPA237UA	SO-8	D	OPA237UA
Dual			
OPA2237EA	MSOP-8	DGK	B37A
OPA2237UA	SO-8	D	OPA2237UA
Quad⁽²⁾			
OPA4237UA	SSOP-16	DBQ	OPA4237UA

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

(2) Quad version is obsolete.

ELECTRICAL CHARACTERISTICS: $V_S = +5V$
Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$.

At $T_A = +25^{\circ}\text{C}$, $V_S = +5V$, $R_L = 10\text{k}\Omega$, connected to $V_S/2$, unless otherwise noted.

PARAMETER	CONDITIONS	OPA237UA, NA OPA2237UA, EA OPA4237UA			UNITS
		MIN	TYP	MAX	
OFFSET VOLTAGE Input Offset Voltage vs Temperature⁽¹⁾ vs Power Supply (PSRR) Channel Separation (dual and quad)	$V_{CM} = 2.5V$ Specified Temperature Range $V_S = +2.7V$ to $+36V$		± 250 ± 2 10 0.5	± 750 ± 5 30	μV $\mu V/^{\circ}\text{C}$ $\mu V/V$ $\mu V/V$
INPUT BIAS CURRENT Input Bias Current ⁽²⁾ Input Offset Current	$V_{CM} = 2.5V$ $V_{CM} = 2.5V$		-10 ± 0.5	-40 ± 10	nA nA
NOISE Input Voltage Noise, $f = 0.1$ to 10Hz Input Voltage Noise Density, $f = 1\text{kHz}$ Current Noise Density, $f = 1\text{kHz}$			1 28 60		μV_{pp} $nV/\sqrt{\text{Hz}}$ $fA/\sqrt{\text{Hz}}$
INPUT VOLTAGE RANGE Common-Mode Voltage Range Common-Mode Rejection Ratio	$V_{CM} = -0.2V$ to $3.5V$	-0.2 78	86	(V+) -1.5	V dB
INPUT IMPEDANCE Differential Common-Mode			$5 \cdot 10^6 \parallel 4$ $5 \cdot 10^9 \parallel 2$		$\Omega \parallel pF$ $\Omega \parallel pF$
OPEN-LOOP GAIN Open-Loop Voltage Gain	$V_O = 0.5V$ to $4V$	80	88		dB
FREQUENCY RESPONSE Gain-Bandwidth Product Slew Rate Settling Time, 0.1% 0.01%	$G = 1$ $G = -1$, 3V Step, $C_L = 100pF$ $G = -1$, 3V Step, $C_L = 100pF$		1.4 0.5 11 16		MHz V/ μs μs μs
OUTPUT Voltage Output, Positive Negative Positive Negative Positive Negative Short-Circuit Current Capacitive Load Drive (stable operation)	$R_L = 100k\Omega$ to Ground $R_L = 100k\Omega$ to Ground $R_L = 100k\Omega$ to $2.5V$ $R_L = 100k\Omega$ to $2.5V$ $R_L = 10k\Omega$ to $2.5V$ $R_L = 10k\Omega$ to $2.5V$	(V+) -1 0.01 (V+) -1 0.12 (V+) -1 0.5	(V+) -0.75 0.001 (V+) -0.75 0.04 (V+) -0.75 0.35 -10/+4		V V V V V V mA
		See Typical Characteristic Curves			
POWER SUPPLY Specified Operating Voltage Operating Range Quiescent Current (per amplifier)		+2.7	+5 170	+36 350	V V μA
TEMPERATURE RANGE Specified Range Operating Range Storage Range Thermal Resistance, θ_{JA} SOT23-5 MSOP-8 SSOP-16 (Obsolete) SO-8		-40 -55 -55		+85 +125 +125	$^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C/W}$ $^{\circ}\text{C/W}$ $^{\circ}\text{C/W}$ $^{\circ}\text{C/W}$

(1) Specified by wafer-level test to 95% confidence.

(2) Positive conventional current flows into the input terminals.

ELECTRICAL CHARACTERISTICS: $V_S = +2.7V$

Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}C$ to $+85^{\circ}C$.

At $T_A = +25^{\circ}C$, $V_S = +2.7V$, $R_L = 10k\Omega$, connected to $V_S/2$, unless otherwise noted.

PARAMETER	CONDITIONS	OPA237UA, NA OPA2237UA, EA OPA4237UA			UNITS
		MIN	TYP	MAX	
OFFSET VOLTAGE					
Input Offset Voltage	$V_{CM} = 1V$		± 250	± 750	μV
vs Temperature⁽¹⁾	Specified Temperature Range		± 2	± 5	$\mu V/^{\circ}C$
vs Power Supply (PSRR)	$V_S = +2.7V$ to $+36V$		10	30	$\mu V/V$
Channel Separation (dual and quad)			0.5		$\mu V/V$
INPUT BIAS CURRENT					
Input Bias Current ⁽²⁾	$V_{CM} = 1V$		-10	-40	nA
Input Offset Current	$V_{CM} = 1V$		± 0.5	± 10	nA
NOISE					
Input Voltage Noise, $f = 0.1$ to $10Hz$			1		μV_{PP}
Input Voltage Noise Density, $f = 1kHz$			28		nV/\sqrt{Hz}
Current Noise Density, $f = 1kHz$			60		fA/\sqrt{Hz}
INPUT VOLTAGE RANGE					
Common-Mode Voltage Range		-0.2		(V+) -1.5	V
Common-Mode Rejection Ratio	$V_{CM} = -0.2V$ to $1.2V$	75	85		dB
INPUT IMPEDANCE					
Differential			$5 \bullet 10^6 \parallel 4$		$\Omega \parallel pF$
Common-Mode			$5 \bullet 10^9 \parallel 2$		$\Omega \parallel pF$
OPEN-LOOP GAIN					
Open-Loop Voltage Gain	$V_O = 0.5V$ to $1.7V$	80	88		dB
FREQUENCY RESPONSE					
Gain-Bandwidth Product			1.2		MHz
Slew Rate	$G = 1$		0.5		V/ μs
Settling Time, 0.1%	$G = -1$, 1V Step, $C_L = 100pF$		5		μs
0.01%	$G = -1$, 1V Step, $C_L = 100pF$		8		μs
OUTPUT					
Voltage Output, Positive	$R_L = 100k\Omega$ to Ground	(V+) -1	(V+) -0.75		V
Negative	$R_L = 100k\Omega$ to Ground	0.01	0.001		V
Positive	$R_L = 100k\Omega$ to $1.35V$	(V+) -1	(V+) -0.75		V
Negative	$R_L = 100k\Omega$ to $1.35V$	0.06	0.02		V
Positive	$R_L = 10k\Omega$ to $1.35V$	(V+) -1	(V+) -0.75		V
Negative	$R_L = 10k\Omega$ to $1.35V$	0.3	0.2		V
Short-Circuit Current			-5/+3.5		mA
Capacitive Load Drive (stable operation)		See Typical Characteristic Curves			
POWER SUPPLY					
Specified Operating Voltage			+2.7		V
Operating Range		+2.7		+36	V
Quiescent Current (per amplifier)			160	350	μA
TEMPERATURE RANGE					
Specified Range		-40		+85	$^{\circ}C$
Operating Range		-55		+125	$^{\circ}C$
Storage Range		-55		+125	$^{\circ}C$
Thermal Resistance, θ_{JA}					
SOT23-5			200		$^{\circ}C/W$
MSOP-8			150		$^{\circ}C/W$
SSOP-16 (Obsolete)			150		$^{\circ}C/W$
SO-8			150		$^{\circ}C/W$

(1) Specified by wafer-level test to 95% confidence.

(2) Positive conventional current flows into the input terminals.

ELECTRICAL CHARACTERISTICS: $V_S = \pm 15V$
Boldface limits apply over the specified temperature range, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$.

At $T_A = +25^\circ\text{C}$, $V_S = \pm 15V$, $R_L = 10k\Omega$, connected to $V_S/2$, unless otherwise noted.

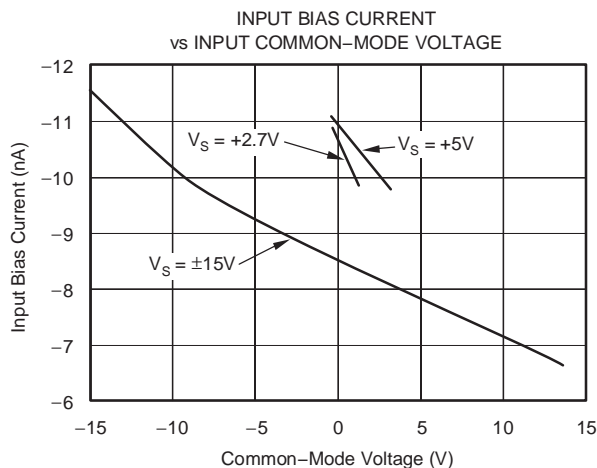
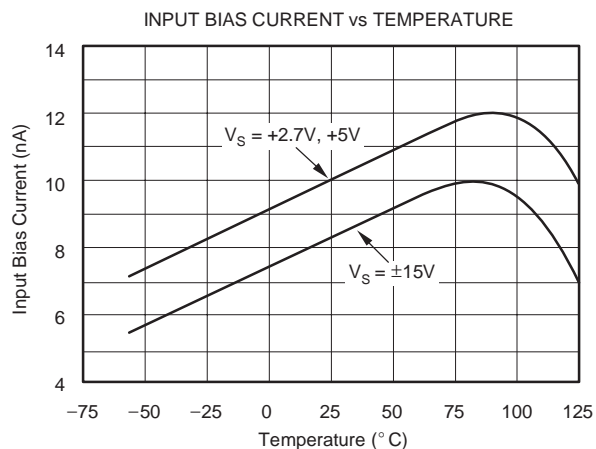
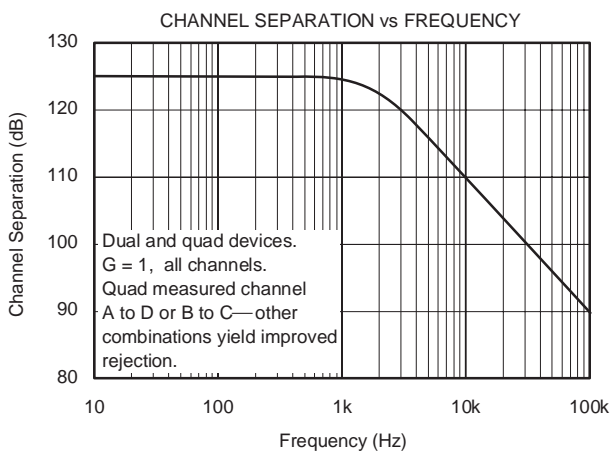
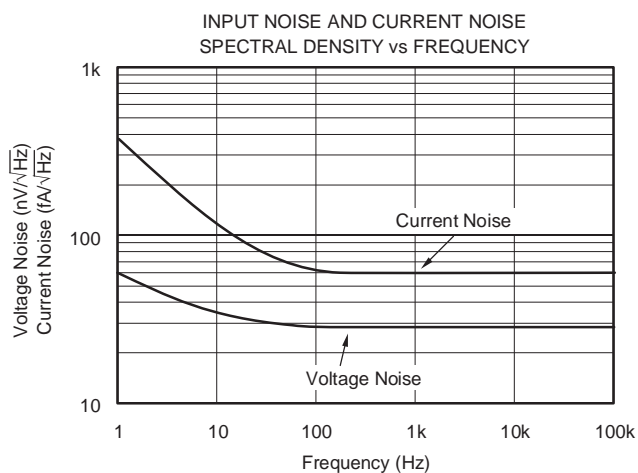
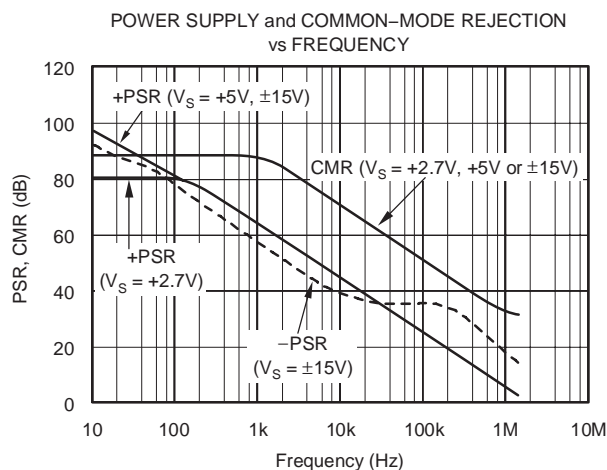
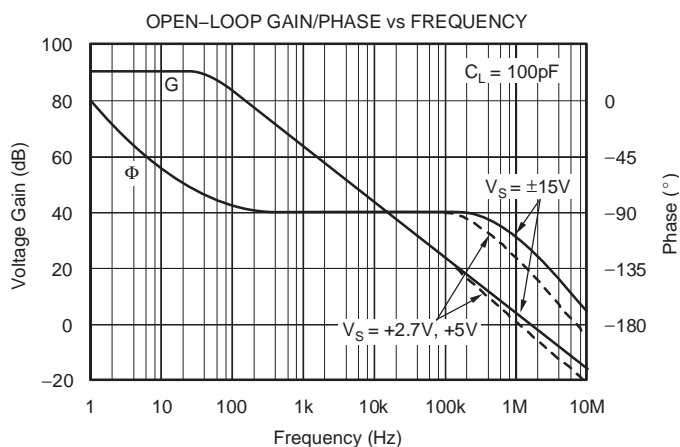
PARAMETER	CONDITIONS	OPA237UA, NA OPA2237UA, EA OPA4237UA			UNITS
		MIN	TYP	MAX	
OFFSET VOLTAGE Input Offset Voltage vs Temperature ⁽¹⁾ vs Power Supply (PSRR) Channel Separation (dual and quad)	$V_{CM} = 0V$ Specified Temperature Range $V_S = \pm 1.35V$ to $\pm 18V$		± 350 ± 2.5 10 0.5	± 950 ± 7 30	μV $\mu V/^\circ\text{C}$ $\mu V/V$ $\mu V/V$
INPUT BIAS CURRENT Input Bias Current ⁽²⁾ Input Offset Current	$V_{CM} = 0V$ $V_{CM} = 0V$		-8.5 ± 0.5	-40 ± 10	nA nA
NOISE Input Voltage Noise, $f = 0.1$ to 10Hz Input Voltage Noise Density, $f = 1\text{kHz}$ Current Noise Density, $f = 1\text{kHz}$			1 28 60		μV_{pp} $nV/\sqrt{\text{Hz}}$ $fA/\sqrt{\text{Hz}}$
INPUT VOLTAGE RANGE Common-Mode Voltage Range Common-Mode Rejection Ratio	$V_{CM} = -15V$ to $13.5V$	(V-) -0.2 80	90	(V+) -1.5	V dB
INPUT IMPEDANCE Differential Common-Mode			$5 \cdot 10^6 \parallel 4$ $5 \cdot 10^9 \parallel 2$		$\Omega \parallel pF$ $\Omega \parallel pF$
OPEN-LOOP GAIN Open-Loop Voltage Gain	$V_O = -14V$ to $13.8V$	80	88		dB
FREQUENCY RESPONSE Gain-Bandwidth Product Slew Rate Settling Time, 0.1% 0.01%	$G = 1$ $G = -1$, 10V Step, $C_L = 100pF$ $G = -1$, 10V Step, $C_L = 100pF$		1.5 0.5 18 21		MHz V/ μs μs μs
OUTPUT Voltage Output, Positive Negative Positive Negative Short-Circuit Current Capacitive Load Drive (stable operation)	$R_L = 100k\Omega$ $R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 10k\Omega$	(V+) -1.2 (V-) +0.5 (V+) -1.2 (V-) +1	(V+) -0.9 (V-) +0.3 (V+) -0.9 (V-) +0.85 -8/+4.5		V V V V mA
		See Typical Characteristic Curves			
POWER SUPPLY Specified Operating Range Operating Range Quiescent Current (per amplifier)		± 1.35	± 15 ± 200	± 18 ± 475	V V μA
TEMPERATURE RANGE Specified Range Operating Range Storage Range Thermal Resistance, θ_{JA} SOT23-5 MSOP-8 SSOP-16 (Obsolete) SO-8		-40 -55 -55		+85 +125 +125	$^\circ\text{C}$ $^\circ\text{C}$ $^\circ\text{C}$
			200 150 150 150		$^\circ\text{C/W}$ $^\circ\text{C/W}$ $^\circ\text{C/W}$ $^\circ\text{C/W}$

(1) Specified by wafer-level test to 95% confidence.

(2) Positive conventional current flows into the input terminals.

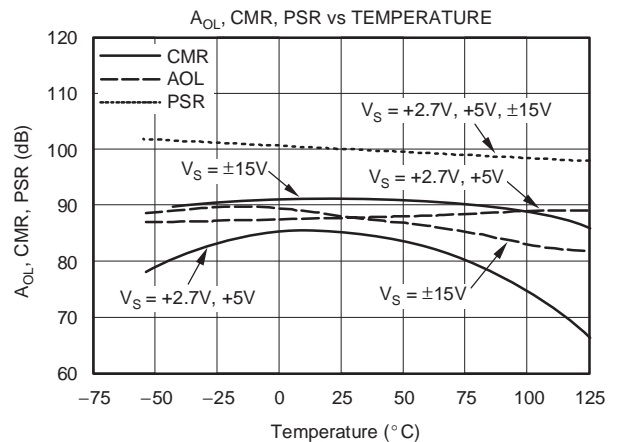
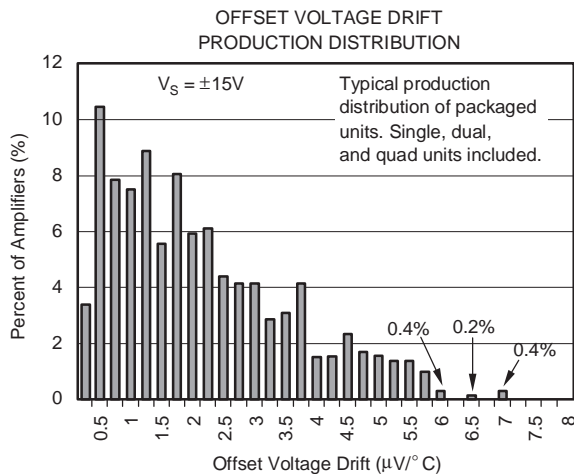
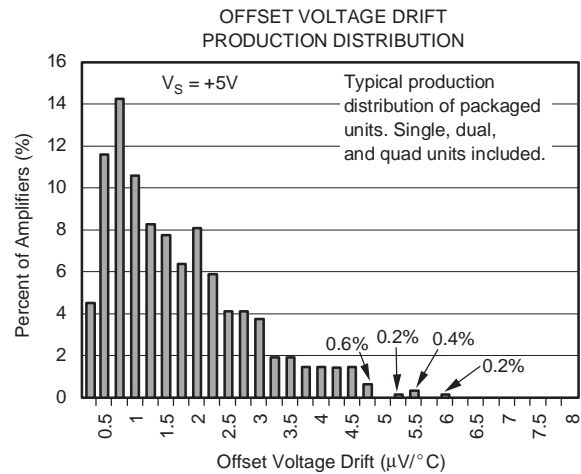
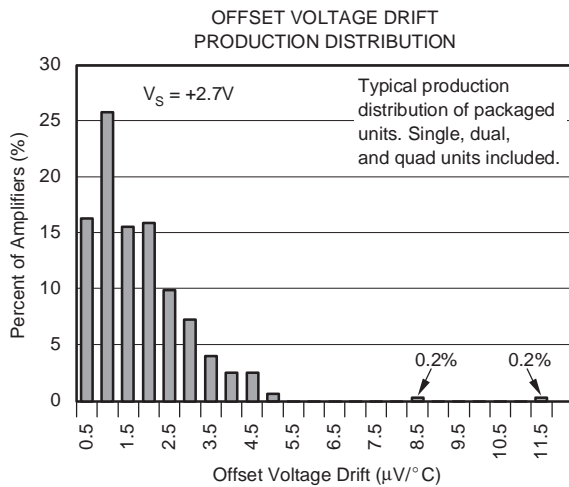
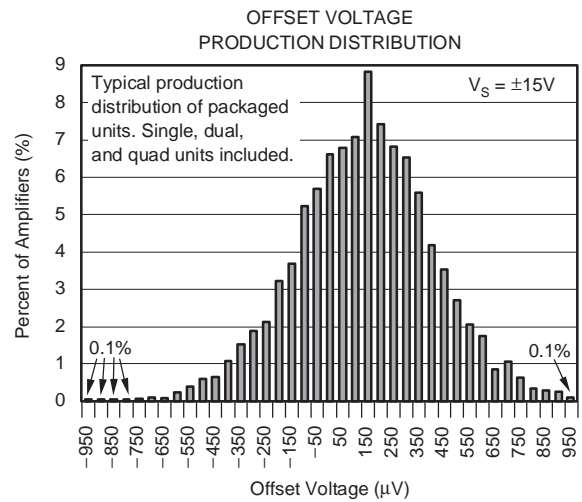
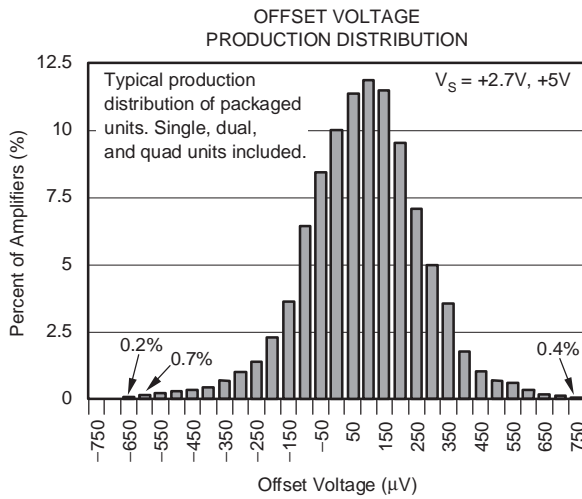
TYPICAL CHARACTERISTICS

At $T_A = +25^\circ\text{C}$ and $R_L = 10\text{k}\Omega$, unless otherwise noted.



TYPICAL CHARACTERISTICS (Continued)

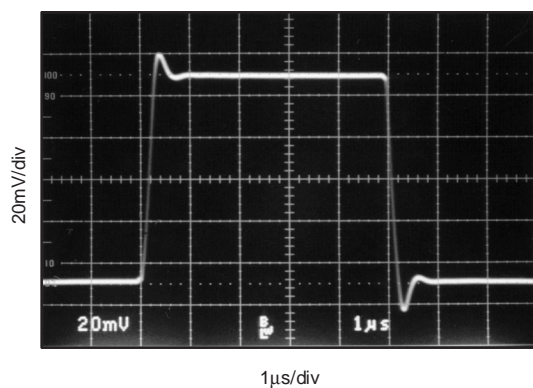
At $T_A = +25^\circ\text{C}$ and $R_L = 10\text{k}\Omega$, unless otherwise noted.



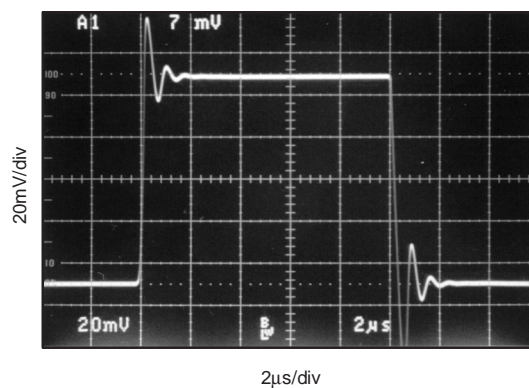
TYPICAL CHARACTERISTICS (Continued)

At $T_A = +25^\circ\text{C}$ and $R_L = 10\text{k}\Omega$, unless otherwise noted.

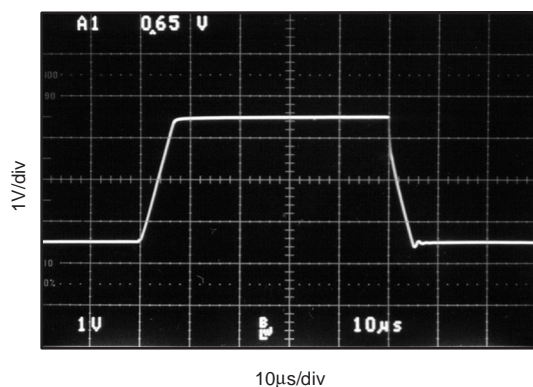
SMALL-SIGNAL STEP RESPONSE
($G = 1$, $C_L = 100\text{pF}$, $V_S = +5\text{V}$)



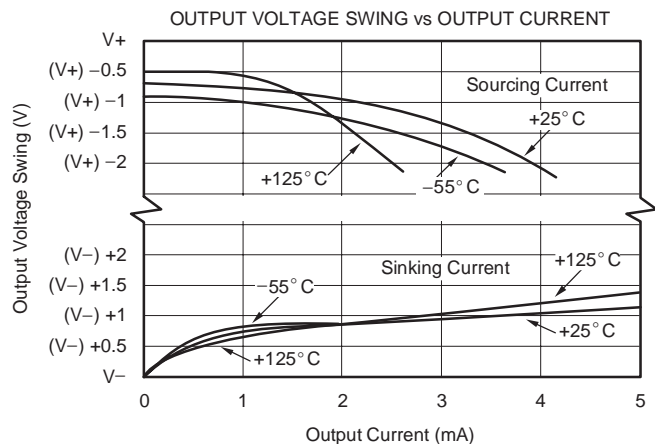
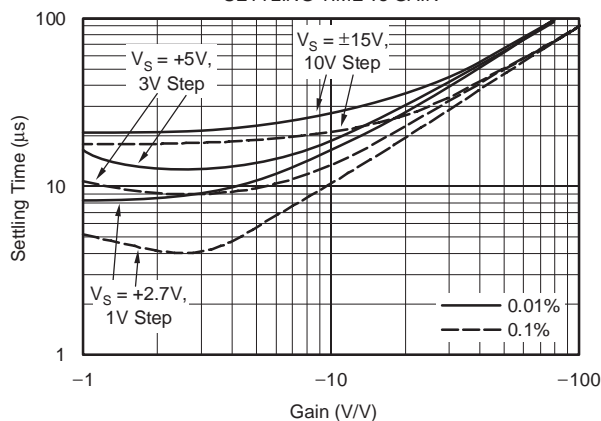
SMALL-SIGNAL STEP RESPONSE
($G = 1$, $C_L = 220\text{pF}$, $V_S = +5\text{V}$)



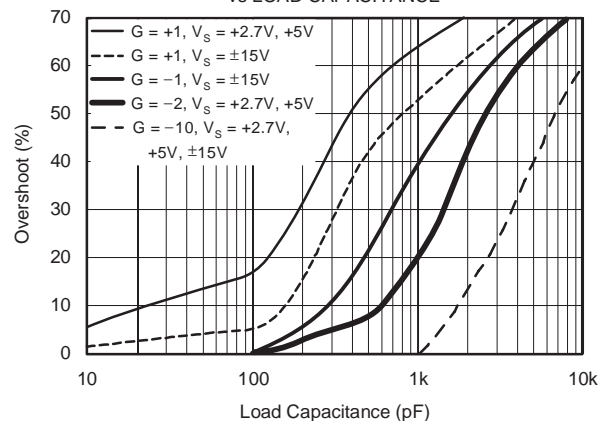
LARGE-SIGNAL STEP RESPONSE
($G = 1$, $C_L = 100\text{pF}$, $V_S = +5\text{V}$)



SETTLING TIME vs GAIN

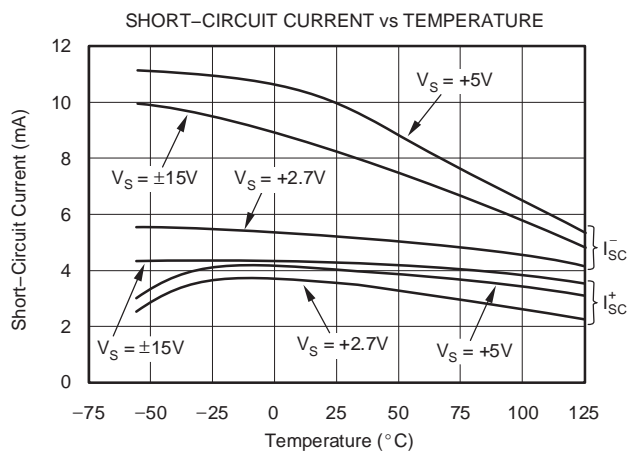
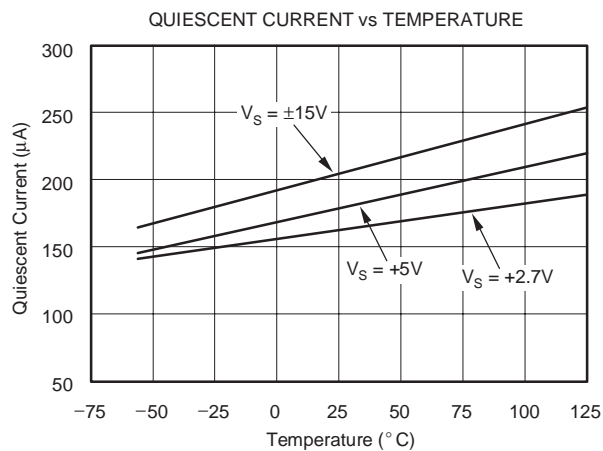
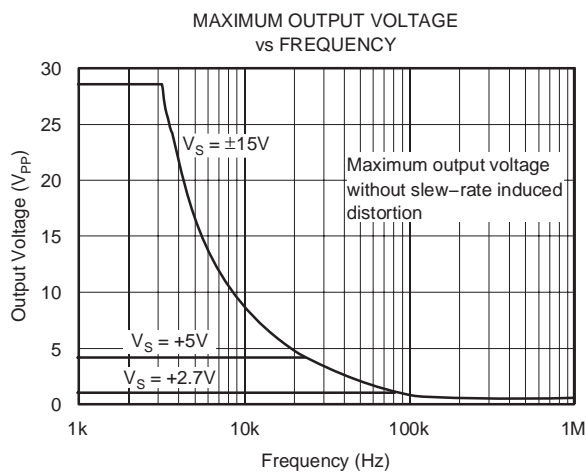


SMALL-SIGNAL OVERSHOOT
vs LOAD CAPACITANCE



TYPICAL CHARACTERISTICS (Continued)

At $T_A = +25^\circ\text{C}$ and $R_L = 10\text{k}\Omega$, unless otherwise noted.



APPLICATION INFORMATION

OPA237 series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. Power supply pins should be bypassed with 10nF ceramic capacitors.

OPERATING VOLTAGE

OPA237 series op amps operate from single (+2.7V to +36V) or dual (± 1.35 V to ± 18 V) supplies with excellent performance. Most behavior remains unchanged throughout the full operating voltage range. Parameters which vary significantly with operating voltage are shown in typical performance curves. Specifications are production tested with +2.7V, +5V, and ± 15 V supplies.

OUTPUT CURRENT AND STABILITY

OPA237 series op amps can drive large capacitive loads. However, under certain limited output conditions any op amp may become unstable. Figure 1 shows the region where the OPA237 has a potential for instability. These load conditions are rarely encountered, especially for single supply applications. For example, take the case when a +5V supply with a 10k Ω load to $V_S/2$ is used.

OPA237 series op amps remain stable with capacitive loads up to 4,000pF, if sinking current and up to 10,000pF, if sourcing current. Furthermore, in single-supply applications where the load is connected to ground, the op amp is only sourcing current, and as shown Figure 1, can drive 10,000pF with output currents up to 1.5mA.

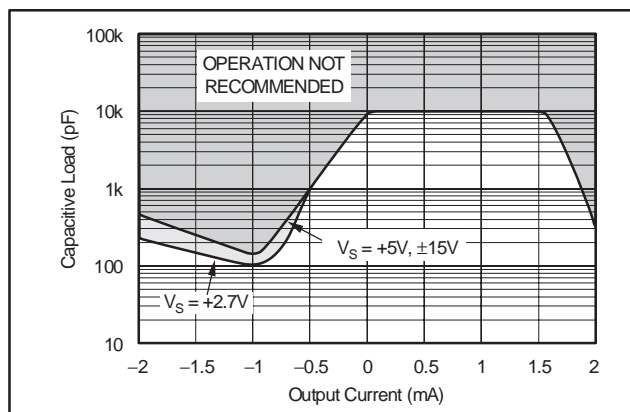


Figure 1. Stability-Capacitive Load vs Output Current

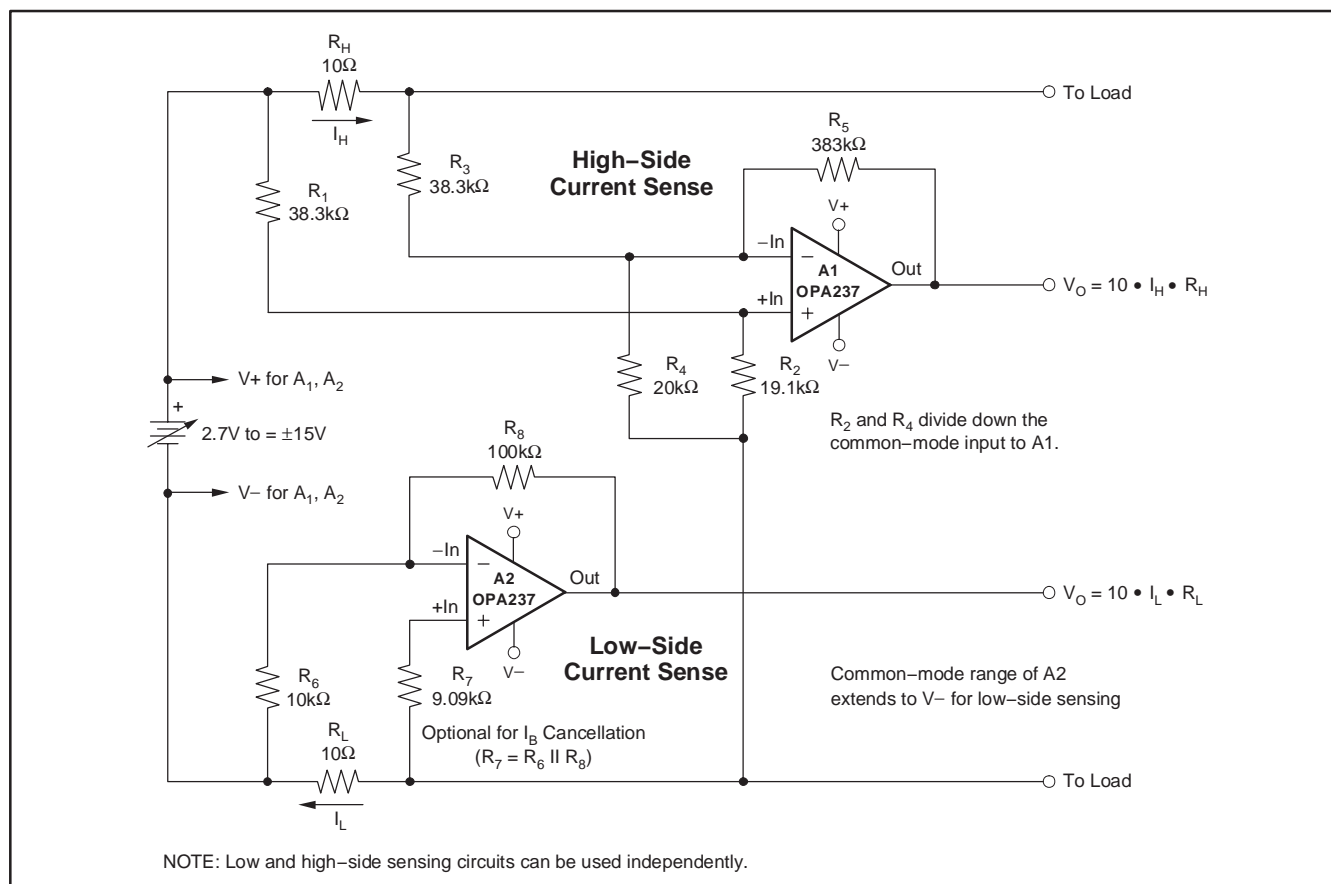


Figure 2. Low and High-Side Battery Current Sensing

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
OPA2237EA/250	ACTIVE	VSSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU CU NIPDAUAG	Level-3-260C-168 HR		B37A	Samples
OPA2237EA/250G4	ACTIVE	VSSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		B37A	Samples
OPA2237EA/2K5	ACTIVE	VSSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU CU NIPDAUAG	Level-3-260C-168 HR	-40 to 85	B37A	Samples
OPA2237EA/2K5G4	ACTIVE	VSSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 85	B37A	Samples
OPA2237UA	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2237UA	Samples
OPA2237UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2237UA	Samples
OPA2237UA/2K5E4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2237UA	Samples
OPA2237UAE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2237UA	Samples
OPA237NA/250	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		A37A	Samples
OPA237NA/250E4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		A37A	Samples
OPA237NA/3K	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		A37A	Samples
OPA237NA/3KE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		A37A	Samples
OPA237UA	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 237UA	Samples
OPA237UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 237UA	Samples
OPA237UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 237UA	Samples
OPA237UAG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 237UA	Samples
OPA4237UA/250	OBSOLETE	SSOP	DBQ	16		TBD	Call TI	Call TI			
OPA4237UA/2K5	OBSOLETE	SSOP	DBQ	16		TBD	Call TI	Call TI	0 to 70		

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
OPA2237EA/250	VSSOP	DGK	8	250	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2237EA/2K5	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA237NA/250	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
OPA237NA/3K	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
OPA237UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS

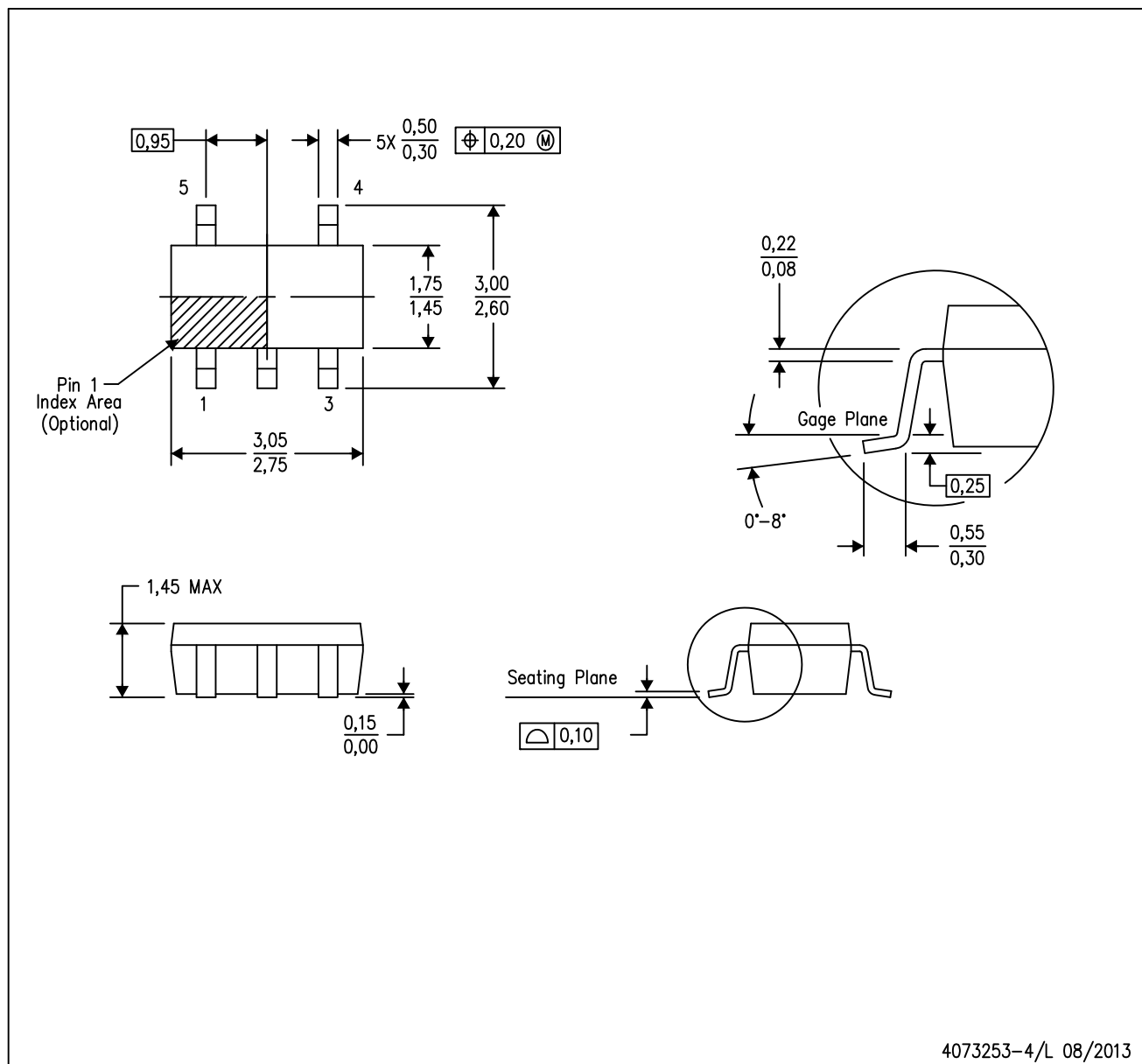


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
OPA2237EA/250	VSSOP	DGK	8	250	366.0	364.0	50.0
OPA2237EA/2K5	VSSOP	DGK	8	2500	366.0	364.0	50.0
OPA237NA/250	SOT-23	DBV	5	250	180.0	180.0	18.0
OPA237NA/3K	SOT-23	DBV	5	3000	180.0	180.0	18.0
OPA237UA/2K5	SOIC	D	8	2500	367.0	367.0	35.0

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-178 Variation AA.

DBV (R-PDSO-G5)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

DGK (S-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



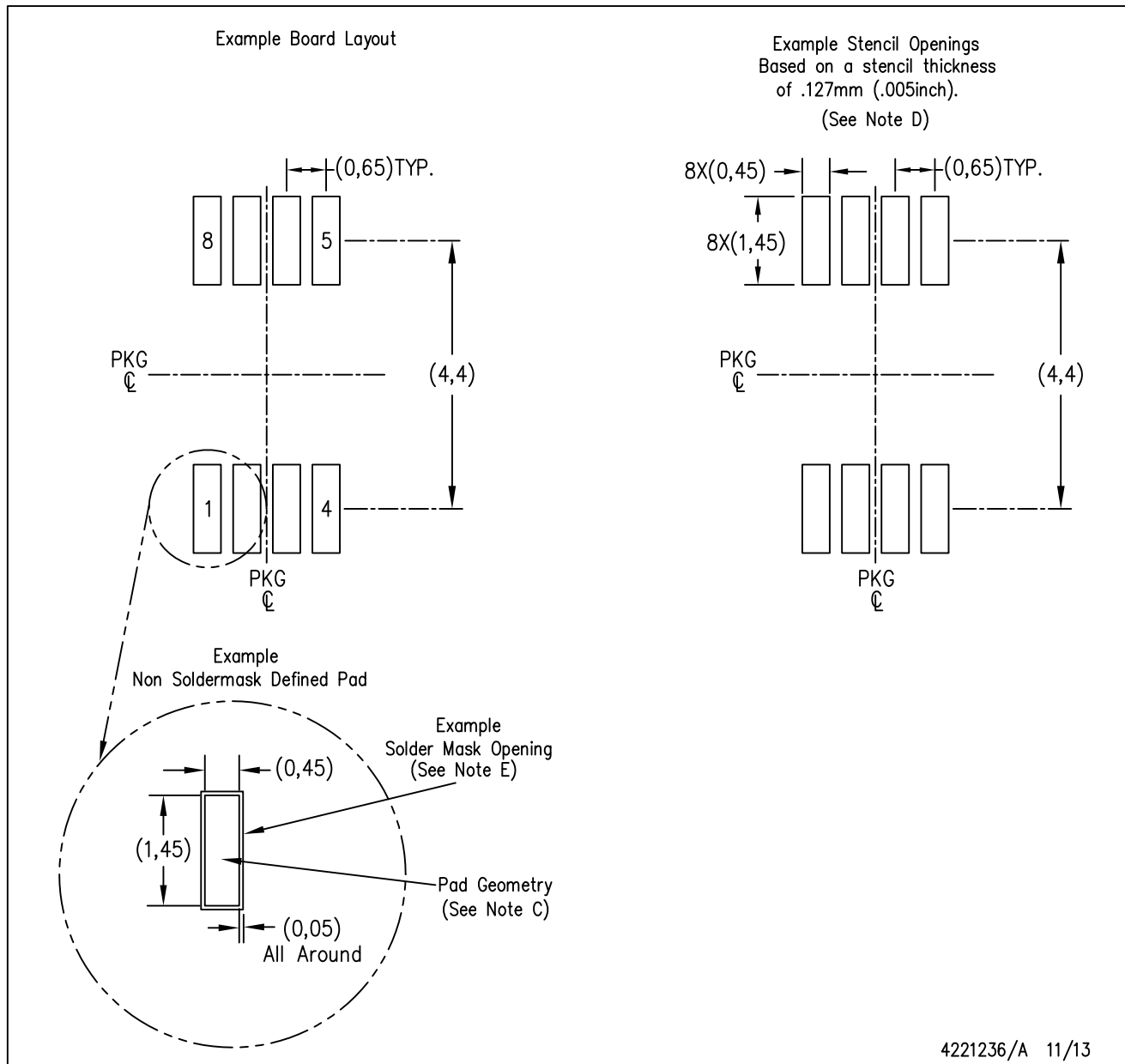
4073329/E 05/06

NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
- D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
- E. Falls within JEDEC MO-187 variation AA, except interlead flash.

DGK (S-PDSO-G8)

PLASTIC SMALL OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - $\triangle D$ Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

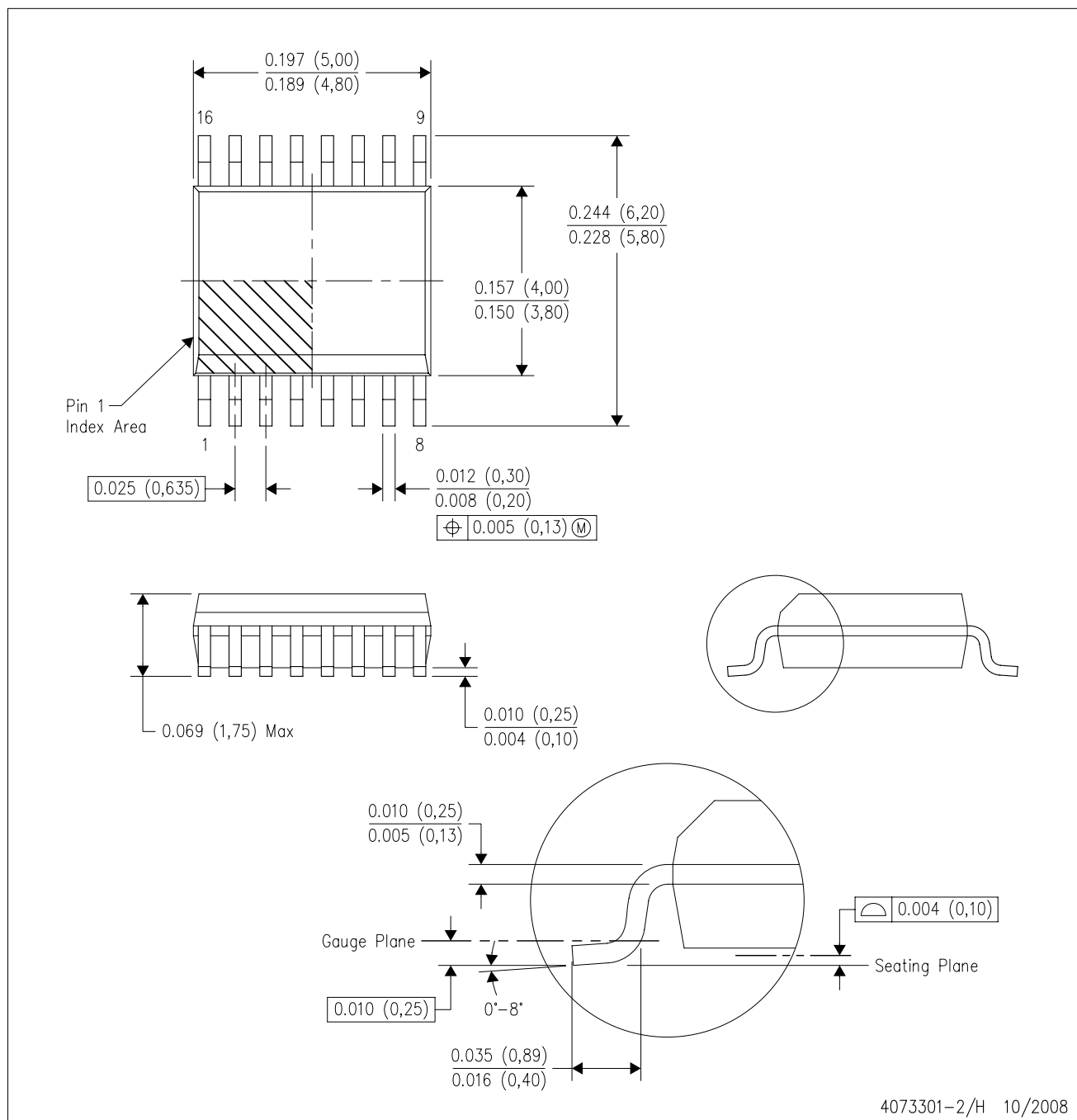
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DBQ (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15) per side.
 - D. Falls within JEDEC MO-137 variation AB.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com